NI 9147
Ethernet Expansion Chassis for C Series Modules

This document describes the features of the NI 9147 and contains information about mounting and operating the device.

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Configuring the NI 9147

You can connect the NI 9147 to a host computer or network and configure the startup options using the USB device port or the RJ-45 Gigabit Ethernet port 1.

Tip Refer to the getting started guide on ni.com/manuals for basic configuration instructions and information about connecting to a host computer using the USB device port. NI recommends using the USB device port for configuration, debug, and maintenance.

Connecting the NI 9147 to the Host Computer or Network Using Ethernet

Complete the following steps to connect the NI 9147 to a host computer or Ethernet network using the RJ-45 Gigabit Ethernet port 1. NI recommends using the RJ-45 Gigabit Ethernet port 1 for communication with deployed systems.

1. Power on the host computer or Ethernet hub.
2. Connect the RJ-45 Gigabit Ethernet port 1 on the NI 9147 to the host computer or Ethernet hub using a standard Category 5 (CAT-5) or better shielded, twisted-pair Ethernet cable.

Caution To prevent data loss and to maintain the integrity of your Ethernet installation, do not use a cable longer than 100 m (328 ft).

The NI 9147 attempts to initiate a DHCP network connection the first time you connect using Ethernet. The NI 9147 connects to the network with a link-local IP address with the form 169.254.x.x if it is unable to initiate a DHCP connection.

Finding the NI 9147 on the Network (DHCP)

Complete the following steps to find the NI 9147 on a network using DHCP.

1. Disable secondary network interfaces on the host computer, such as a wireless access card on a laptop.
2. Ensure that any anti-virus and firewall software running on the host computer allows connections to the host computer.

Note MAX uses UDP 44525. Refer to the documentation of your firewall software for information about configuring the firewall to allow communication through the UDP 44525.
3. Launch MAX on the host computer.
4. Expand **Remote Systems** in the configuration tree and locate your system.

**Tip** MAX lists the system under the model number followed by the serial number, such as NI-CRIO-9147-1856AAA.

### Configuring Startup Options

Complete the following steps to configure the NI 9147 startup options in MAX.

1. In MAX, expand your system under Remote Systems.
2. Select the **Startup Settings** tab to configure the startup settings.

### NI 9147 Startup Options

You can configure the following NI 9147 startup options.

<table>
<thead>
<tr>
<th>Startup Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Force Safe Mode</strong></td>
<td>Rebooting the NI 9147 with this setting on starts the NI 9147 without launching LabVIEW Real-Time or any startup applications. In safe mode, the NI 9147 launches only the services necessary for updating configuration and installing software.</td>
</tr>
<tr>
<td><strong>Disable FPGA Startup App</strong></td>
<td>Rebooting the NI 9147 with this setting on prevents autoloading of any FPGA application.</td>
</tr>
<tr>
<td><strong>Enable Secure Shell (SSH) Logins</strong></td>
<td>Rebooting the NI 9147 with this setting on starts sshd on the NI 9147. Starting sshd enables logins over SSH, an encrypted communication protocol.</td>
</tr>
</tbody>
</table>

**Note** When you reset the cRIO-906x controller either programmatically or by using the RESET button, you also reset the FPGA. All FPGA I/O lines are tri-stated after a reset, and will enter predefined states once loaded.

**Note** Visit [ni.com/info](http://ni.com/info) and enter the Info Code `openssh` for more information about SSH.

### NI 9147 Features

The NI 9147 provides the following features.

#### Ports and Connectors

The NI 9147 provides the following ports and connectors.
1. USB Device Port
2. RJ-45 Ethernet Port 1
3. Power Connector

**RJ-45 Gigabit Ethernet Port**

The NI 9147 has one tri-speed RJ-45 Gigabit Ethernet port. By default, the Ethernet port is enabled and configured to obtain an IP address automatically. The Ethernet port can be configured in MAX.

The following table shows the pinout for the RJ-45 Gigabit Ethernet port.
Table 2. RJ-45 Gigabit Ethernet Port Pinout

<table>
<thead>
<tr>
<th>Fast Ethernet Signal</th>
<th>Gigabit Ethernet Signal</th>
<th>Pin</th>
<th>Pinout</th>
</tr>
</thead>
<tbody>
<tr>
<td>TX+</td>
<td>TX_A+</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>TX-</td>
<td>TX_A-</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>RX+</td>
<td>RX_B+</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>No Connect</td>
<td>TX_C+</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>No Connect</td>
<td>TX_C-</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>RX-</td>
<td>RX_B-</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>No Connect</td>
<td>RX_D+</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>No Connect</td>
<td>RX_D-</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

**Note** The Ethernet port performs automatic crossover configuration so you do not need to use a crossover cable to connect to a host computer.

The following NI Ethernet cables are available for the NI 9147.

Table 3. RJ-45 Gigabit Ethernet Cables

<table>
<thead>
<tr>
<th>Cables</th>
<th>Length</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAT-5E Ethernet Cable, shielded</td>
<td>2 m</td>
<td>151733-02</td>
</tr>
<tr>
<td></td>
<td>5 m</td>
<td>151733-05</td>
</tr>
<tr>
<td></td>
<td>10 m</td>
<td>151733-10</td>
</tr>
</tbody>
</table>

**Related Information**

*Ethernet LED Indicators* on page 10

**Power Connector**

The NI 9147 has a power connector to which you can connect a power supply. The following table shows the pinout for the power connector.

Table 4. Power Connector Pinout

<table>
<thead>
<tr>
<th>Pinout</th>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Power Connector Diagram]</td>
<td>V</td>
<td>Power input</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>Common</td>
</tr>
</tbody>
</table>
Caution  The C terminal is not connected to chassis ground. You can connect the C
terminal to chassis ground externally. Refer to the specifications on ni.com/manuals
for information about the power supply input range and maximum voltage from
terminal to chassis ground.

The NI 9147 has reverse-voltage protection.

The following NI power supplies and accessories are available for the NI 9147.

<table>
<thead>
<tr>
<th>Accessory</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>NI PS-10 Desktop Power Supply, 24 VDC, 5 A, 100-120/200-240 VAC Input</td>
<td>782698-01</td>
</tr>
<tr>
<td>NI PS-14 Industrial Power Supply, 24 to 28 VDC, 3.3 A, 100-240 VAC Input</td>
<td>783167-01</td>
</tr>
<tr>
<td>NI PS-15 Industrial Power Supply, 24 to 28 VDC, 5 A, 100/230 VAC Input</td>
<td>781093-01</td>
</tr>
<tr>
<td>NI PS-16 Industrial Power Supply, 24 to 28 VDC, 10 A, 115/230 VAC Input</td>
<td>781094-01</td>
</tr>
<tr>
<td>NI PS-17 Industrial Power Supply, 24 to 28 VDC, 20 A, 85-276 VAC Input</td>
<td>781095-01</td>
</tr>
</tbody>
</table>

Related Information
POWER LED Indicators on page 9

USB Device Port

The NI 9147 USB device port is intended for device configuration, application deployment,
debugging, and maintenance. For example, you can use the USB device port to install software
or driver updates during field maintenance instead of interrupting communication on the RJ-45
Ethernet ports.

Caution  Do not hot-swap USB devices while the NI 9147 is in a hazardous
location or connected to high voltages. If the NI 9147 is not in a hazardous location,
you can connect and disconnect USB devices without affecting operation.

The following table shows the pinout for the USB device port.

<table>
<thead>
<tr>
<th>Description</th>
<th>Signal</th>
<th>Pin</th>
<th>Pinout</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB data+</td>
<td>D+</td>
<td>3</td>
<td><img src="image" alt="USB pinout" /></td>
</tr>
<tr>
<td>Ground</td>
<td>GND</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following NI cable is available for the NI 9147.
Table 6. USB Device Port Cable

<table>
<thead>
<tr>
<th>Cable</th>
<th>Length</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>NI Locking USB Cable</td>
<td>1 m</td>
<td>157788-01</td>
</tr>
</tbody>
</table>

Buttons

The NI 9147 provides the following buttons.

**Figure 2. NI 9147 Buttons**

1. **RESET Button**

RESET Button

Press the RESET button to reset the processor in the same manner as cycling power.

Troubleshooting Network Connectivity

You can use the RESET button to troubleshoot network connectivity.

Complete the following steps to reset the network adapters to default settings.

1. Hold the RESET button for 5 seconds, and then release it to boot the controller in safe mode and enable Console Out.
2. Hold the RESET button again for 5 seconds to boot the controller into safe mode, enable Console Out, and reset network adapters to default settings.
System Reset
The following figure shows the reset behavior of the NI 9147.

**Figure 3.** Reset Button Behavior

- Press and hold RESET button for $\geq 5$ s
- **Run Mode**
- Press and hold RESET button for $< 5$ s

- **Safe Mode**
  - Press and hold RESET button for $\geq 5$ s
  - *FPGA Startup App disabled*
  - *Network settings reset*
  - *FPGA Startup App disabled*

- Press and hold RESET button for $< 5$ s

LEDs
The NI 9147 provides the following LEDs.

**Figure 4.** NI 9147 LEDs

1. **POWER LED**
2. **STATUS LED**
3. **USER1 LED**
4. **USER FPGA1 LED**
5. **RJ-45 Ethernet LEDs**
POWER LED Indicators
The following table lists the POWER LED indicators.

<table>
<thead>
<tr>
<th>LED Pattern</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid</td>
<td>The NI 9147 is powered on.</td>
</tr>
<tr>
<td>Off</td>
<td>The NI 9147 is powered off.</td>
</tr>
</tbody>
</table>

STATUS LED Indicators
The following table describes the STATUS LED indicators.

<table>
<thead>
<tr>
<th>LED Pattern</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blinks twice and</td>
<td>The NI 9147 is in safe mode. Software is not installed, which is the</td>
</tr>
<tr>
<td>pauses</td>
<td>factory default state, or software has been improperly installed on the</td>
</tr>
<tr>
<td></td>
<td>NI 9147.</td>
</tr>
<tr>
<td></td>
<td>An error can occur when an attempt to upgrade the software is</td>
</tr>
<tr>
<td></td>
<td>interrupted. Reinstall software on the NI 9147. Refer to the Measurement</td>
</tr>
<tr>
<td></td>
<td>&amp; Automation Explorer (MAX) Help for information about installing software on</td>
</tr>
<tr>
<td></td>
<td>the NI 9147.</td>
</tr>
<tr>
<td>Blinks three times</td>
<td>The NI 9147 is in user-directed safe mode, or the NI 9147 is in install</td>
</tr>
<tr>
<td>and pauses</td>
<td>mode to indicate that software is currently being installed.</td>
</tr>
<tr>
<td></td>
<td>This pattern may also indicate that the user has forced the NI 9147 to</td>
</tr>
<tr>
<td></td>
<td>boot into safe mode by pressing the reset button for longer than five</td>
</tr>
<tr>
<td></td>
<td>seconds or by enabling safe mode in MAX. Refer to the Measurement &amp;</td>
</tr>
<tr>
<td></td>
<td>Automation Explorer (MAX) Help for information about safe mode.</td>
</tr>
<tr>
<td>Blinks four times</td>
<td>The NI 9147 is in safe mode. The software has crashed twice without</td>
</tr>
<tr>
<td>and pauses</td>
<td>rebooting or cycling power between crashes.</td>
</tr>
<tr>
<td>Continuously blinks</td>
<td>The NI 9147 has not booted into NI Linux Real-Time. The NI 9147 either</td>
</tr>
<tr>
<td></td>
<td>booted into an unsupported operating system, was interrupted during the</td>
</tr>
<tr>
<td></td>
<td>boot process, or detected an unrecoverable software error.</td>
</tr>
<tr>
<td>On momentarily</td>
<td>The NI 9147 is booting. No action required.</td>
</tr>
<tr>
<td>Off</td>
<td>The NI 9147 is in run mode. Software is installed and the operating system</td>
</tr>
<tr>
<td></td>
<td>is running.</td>
</tr>
</tbody>
</table>
User LED
You can define the USER FPGA1 LED to meet the needs of your application. The following table lists the USER FPGA1 LED indicators.

<table>
<thead>
<tr>
<th>LED</th>
<th>LED Color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>USER FPGA1</td>
<td>Green/Yellow</td>
<td>Use the LabVIEW FPGA Module and NI-RIO Device Drivers software to define the USER FPGA1 LED. Use the USER FPGA1 LED to help debug your application or retrieve application status. Refer to the LabVIEW Help for information about programming this LED.</td>
</tr>
</tbody>
</table>

Ethernet LED Indicators
The following table lists the Ethernet LED indicators.

<table>
<thead>
<tr>
<th>LED</th>
<th>LED Color</th>
<th>LED Pattern</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACT/LINK</td>
<td>—</td>
<td>Off</td>
<td>LAN link not established</td>
</tr>
<tr>
<td>Green</td>
<td>Solid</td>
<td>Off</td>
<td>LAN link established</td>
</tr>
<tr>
<td></td>
<td>Flashing</td>
<td></td>
<td>Activity on LAN</td>
</tr>
<tr>
<td>10/100/1000</td>
<td>Yellow</td>
<td>Solid</td>
<td>1,000 Mbit/s data rate selected</td>
</tr>
<tr>
<td>Green</td>
<td>Solid</td>
<td>Off</td>
<td>10 Mbit/s data rate selected</td>
</tr>
</tbody>
</table>

Chassis Grounding Screw
The NI 9147 provides a chassis grounding screw.

For EMC compliance, you must connect the NI 9147 to earth ground through the chassis ground screw. Use wire that is 1.31 mm² (16 AWG) solid copper wire with a maximum length of 1.5 m (5 ft). Attach the wire to the earth ground of the electrode system of the facility.
Caution  If you use shielded cabling to connect to a C Series module with a plastic connector, you must attach the cable shield to the chassis grounding terminal using 1.31 mm² (16 AWG) or larger wire. Attach a ring lug to the wire and attach the wire to the chassis grounding terminal. Solder the other end of the wire to the cable shield. Use shorter wire for better EMC performance.

For more information about ground connections, visit ni.com/info and enter the Info Code emcground.

Internal Real-Time Clock
The NI 9147 contains an internal real-time clock that maintains system time when the NI 9147 is powered off. The system clock of the NI 9147 is synchronized with the internal real-time clock at startup. You can set the real-time clock using MAX, or you can set the clock programmatically using LabVIEW.

Refer to the specifications on ni.com/manuals for the real-time clock accuracy specifications.

Battery
The NI 9147 contains a lithium cell battery that stores the system clock information when the NI 9147 is powered off. There is only a slight drain on the battery when power is applied to the NI 9147 power connector. The rate at which the battery drains when power is disconnected depends on the ambient storage temperature. For longer battery life, store the NI 9147 at a cooler temperature and apply power to the power connector. Refer to the specifications on ni.com/manuals for the expected battery lifetime.

The battery is not user-replaceable. If you need to replace the battery, contact NI. Refer to the specifications on ni.com/manuals for information about battery disposal.

Mounting the Device
To obtain the maximum allowable ambient temperature of 70 °C, you must mount the NI 9147 horizontally on a flat, metallic, vertical surface such as a panel or wall. You can mount the NI 9147 directly to the surface or use the NI Panel Mounting Kit. The following figure shows the NI 9147 mounted horizontally.

Figure 6. NI 9147 Horizontal Mounting
You can also mount the NI 9147 in other orientations, on a nonmetallic surface, on a 35-mm DIN rail, on a desktop, or in a rack. Mounting the NI 9147 in these or other configurations can reduce the maximum allowable ambient temperature and can affect the typical accuracy of modules in the NI 9147. For more information about typical accuracy specifications for C Series modules and temperature deratings caused by different mounting configurations, visit ni.com/info and enter the Info Code criotypical.

⚠️ **Caution** Make sure that no C Series modules are in the NI 9147 before mounting it.

💡 **Tip** Before using any of these mounting methods, record the serial number from the back of the NI 9147 so that you can identify the NI 9147 in MAX. You will be unable to read the serial number after you mount the NI 9147.

### Dimensions

The following figures show the front and side dimensions of the NI 9147. For detailed dimensional drawings and 3D models, visit [ni.com/dimensions](http://ni.com/dimensions) and search for the module number.

**Figure 7. NI 9147 Front Dimensions**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>87.3 mm</td>
</tr>
<tr>
<td>(3.44 in.)</td>
<td></td>
</tr>
<tr>
<td>Width</td>
<td>178.1 mm</td>
</tr>
<tr>
<td>(7.01 in.)</td>
<td></td>
</tr>
<tr>
<td>Depth</td>
<td>4.1 mm</td>
</tr>
<tr>
<td>(0.16 in.)</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 8. NI 9147 Side Dimensions**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>44.1 mm</td>
</tr>
<tr>
<td>(1.74 in.)</td>
<td></td>
</tr>
<tr>
<td>Width</td>
<td>29.1 mm</td>
</tr>
<tr>
<td>(1.15 in.)</td>
<td></td>
</tr>
<tr>
<td>Depth</td>
<td>14.1 mm</td>
</tr>
<tr>
<td>(0.55 in.)</td>
<td></td>
</tr>
</tbody>
</table>
Mounting Requirements

Your installation must meet the following requirements for cooling and cabling clearance.

Allow 25.4 mm (1.00 in.) on the top and the bottom of the NI 9147 for air circulation, as shown in the following figure.

**Figure 9. NI 9147 Cooling Dimensions**

Allow the appropriate space in front of C Series modules for cabling clearance, as shown in the following figure. The different connector types on C Series modules require different cabling clearances. For a complete list of cabling clearances for C Series modules, visit *ni.com/info* and enter the Info Code *crioconn*.

**Figure 10. NI 9147 Cabling Clearance**

Ambient Temperature

Measure the ambient temperature at each side of the NI 9147, 63.5 mm (2.50 in.) from the side and 25.4 mm (1.00 in.) forward from the rear of the NI 9147, as shown in the following figure.
Mounting the Device Directly on a Flat Surface

For environments with high shock and vibration, NI recommends mounting the NI 9147 directly on a flat, rigid surface using the mounting holes in the NI 9147.

What to Use

- NI 9147
- Screwdriver, Phillips #2
- M4 or number 8 screw (x2), user-provided, longer than 23.00 mm (0.91 in.) to pass all the way through the NI 9147

What to Do

Complete the following steps to mount the NI 9147 directly on a flat surface.
1. Prepare the surface for mounting the NI 9147 using the *Surface Mounting Dimensions*.
2. Align the NI 9147 on the surface.
3. Fasten the NI 9147 to the surface using the M4 or number 8 screws appropriate for the surface. Tighten the screws to a maximum torque of 1.3 N · m (11.5 lb · in.).

**Surface Mounting Dimensions**
The following figure shows the surface mounting dimensions for the NI 9147.

![Figure 12. NI 9147 Surface Mounting Dimensions](image)

**Mounting the Device on a Panel**
You can use the NI panel mounting kit to mount the NI 9147 on a panel.
What to Use

- NI 9147
- Screwdriver, Phillips #2
- NI panel mounting kit, 779097-01
  - Panel mounting plate
  - M5 or number 10 screw (x4)

What to Do

Complete the following steps to mount the NI 9147 on a panel.

1. Align the NI 9147 and the panel mounting plate.
2. Fasten the panel mounting plate to the NI 9147 using the screwdriver and M5 or number 10 screws. NI provides these screws with the panel mounting kit. Tighten the screws to a maximum torque of 1.3 N \cdot m (11.5 lb \cdot in.).
   
   **Note** You must use the screws provided with the NI panel mounting kit because they are the correct depth and thread for the panel mounting plate.

3. Fasten the panel mounting plate to the surface using the screwdriver and screws that are appropriate for the surface. The maximum screw size is M5 or number 10.

Panel Mounting Dimensions

The following figure shows the panel mounting dimensions for the NI 9147.
Mounting the Device on a DIN Rail

You can use the NI DIN rail mounting kit to mount the NI 9147 on a standard 35-mm DIN rail.

What to Use
- NI 9147
- Screwdriver, Phillips #2
- NI DIN rail mounting kit, 779019-01
  - DIN rail clip
  - M4 × 25 flathead screw (x2)

What to Do
Complete the following steps to mount the NI 9147 on a DIN rail.

1. Align the NI 9147 and the DIN rail clip.
2. Fasten the DIN rail kit to the NI 9147 using the screwdriver and M4 × 25 flathead screws. NI provides these screws with the DIN rail mounting kit. Tighten the screws to a maximum torque of 1.3 N · m (11.5 lb · in.).

Note You must use the screws provided with the NI DIN rail mounting kit because they are the correct depth and thread for the DIN rail clip.

Clipping the Device on a DIN Rail

Complete the following steps to clip the NI 9147 on a DIN rail.

1. Insert one edge of the DIN rail into the deeper opening of the DIN rail clip.
2. Press down firmly to compress the spring until the clip locks in place on the DIN rail.

Caution Ensure that no C Series modules are in the NI 9147 before removing it from the DIN rail.

Mounting the Device on a Rack

You can use the following rack mount kits to mount the NI 9147 and other DIN rail-mountable equipment on a standard 482.6 mm (19 in.) rack.

• NI Sliding Rack-Mounting Kit, 779102-01
• NI Rack-Mounting Kit, 781989-01

Note You must use the NI DIN rail mounting kit, 779019-01, in addition to a rack-mounting kit.

Mounting the Device on a Desktop

You can use the NI desktop mounting kit to mount the NI 9147 on a desktop.

What to Use

• NI 9147
• Screwdriver, Phillips #2
• NI desktop mounting kit, 779473-01
  – Desktop mounting brackets (x2)

What to Do

Complete the following steps to mount the NI 9147 on a desktop.
1. Align the brackets with the mounting holes on the ends of the NI 9147.
2. Use the screwdriver to tighten the captive screws on the end of the brackets.

Worldwide Support and Services

The NI website is your complete resource for technical support. At ni.com/support, you have access to everything from troubleshooting and application development self-help resources to email and phone assistance from NI Application Engineers.

Visit ni.com/services for NI Factory Installation Services, repairs, extended warranty, and other services.

Visit ni.com/register to register your NI product. Product registration facilitates technical support and ensures that you receive important information updates from NI.

A Declaration of Conformity (DoC) is our claim of compliance with the Council of the European Communities using the manufacturer’s declaration of conformity. This system affords the user protection for electromagnetic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting ni.com/certification. If your product supports calibration, you can obtain the calibration certificate for your product at ni.com/calibration.

NI corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. NI also has offices located around the world. For telephone support in the United States, create your service request at ni.com/support or dial 1 866 ASK MYNI (275 6964). For telephone support outside the United States, visit the Worldwide Offices section of ni.com/niglobal to access the branch office websites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.